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APPLICATION FOR THE UNITED STATES PATENT OFFICE

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TITLE: UNIVERSAL NON-POROUS FIBER REINFORCED COMBUSTION CHAMBER

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UNIVERSAL NON-POROUS FIBER REINFORCED COMBUSTION CHAMBER FIREPLACE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a universal combustion chamber useful for installation in metal fabricated fireplaces or a stand alone combustion chamber. More particularly, the present invention relates to an assembled non-porous cast fiber-reinforced combustion chamber that is machinable in its cured stage and moldable in its uncured preformed stage.

2. Description of the Prior Art

Heretofore, panels made from high temperature ceramic materials were known. Heat-N-Glow of Savage, Minnesota has incorporated high temperature ceramic panels under the gas burners of some of their gas fireplaces in the form of loose panels. Heat-N-Glow has also incorporated both refractory firebrick and cast ceramic blocks or panels in numerous stoves and fireplaces for insulation purposes as well as for aesthetic purposes.

Manufacturers of commercial and home heating systems have employed cast refractory fireboxes in the base of furnaces. Such refractory fireboxes are protected against exhaust leakage because they are placed in an area

where leakage would not escape from the furnace or boiler or are completely backed up by another non-porous sheet or wall.

Unvented or non-vented gas heaters and fireplaces are not concerned with preventing escape of burned exhaust gasses into a living area, thus, do not totally enclose the combustion chamber or burners. Such unvented gas stoves have been known to deplete the oxygen supply in a living area.

Applicants are not aware of any gas fireplace which employs a gas combustion chamber that virtually eliminates the need for any fireplace enclosure or shroud around the gas combustion chamber for heat protection.

It would be desirable to provide a universal combustion chamber which would accommodate a variety of gas burners and a variety of vents. It would further be desirable to provide an assembled leak proof combustion chamber made from non-porous cast fiber reinforced moldable and machinable material that is cool enough at its outer surface to be installed without additional insulation or heat protective barriers on the outside of the combustion chamber.

SUMMARY OF THE INVENTION

It is a principal object of the present invention to provide an assembled gas fireplace combustion chamber

3

that comprises a plurality of non-porous cast fiber reinforced panels.

It is another principal object of the present invention to provide a fabricated kit of non-porous cast fiber reinforced panels that are accurately formed to be assembled into a leak proof fireplace combustion chamber.

It is another principal object of the present invention to provide an assembled prefabricated non-porous cast fiber reinforced combustion chamber that is machined and ready for installation of a gas burner.

It is another principal object of the present invention to provide a plurality of assembled or unassembled machined non-porous cast fiber reinforced panels that when assembled form a combined combustion chamber and fireplace ready for completion by addition of a gas burner and/or a gas vent.

It is yet another object of the present invention to provide a universal gas combustion chamber/fireplace unit that does not require a metal enclosure for operation in a fireplace.

It is yet another principal object of the present invention to provide a universal gas combustion chamber/ fireplace unit that is operable with a gas burner and has an outer wall temperature cool enough to meet standards for zero clearance installations.

4

It is another object of the present invention to lower the cost of manufacturing gas fireplace units while increasing their efficiency by combining the functions normally associated with a separate gas combustion chamber and fireplace enclosure.

According to these and other objects of the present invention there is provided a universal gas combustion chamber of the type having a bottom floor panel, a top panel and vertical side panels assembled to form a fireplace when a gas burner is installed in or on the floor panel. Said gas combustion chamber panels being made from a moldable slurry of refractory ceramic fibers (preferably vitreous alumina silicate fibers) and a binder (preferably amorphous silica) to form strong machinable fiber reinforced panels.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a section in side elevation taken through a novel assembled non-porous cast ceramic fiber combustion chamber having a burner opening in the floor panel and an exhaust opening in the top panel and installed flush mounted as a vented gas fireplace;

Figure 2 is a front view of the vented fireplace shown in Figure 1 showing a decorative surround with a simulated brick pattern which compliments the pattern in the interior of the non-porous cast ceramic combustion chamber;

5

Figure 3 is a section and side elevation taken through a modified assembled ceramic combustion chamber having a metal rear panel and a fireplace enclosure which forms a heat exchanger around the bottom, back and top of said combustion chamber;

Figure 4 is diagrammatic drawing in sectional plan view of the combustion chamber of Figure 1;

Figure 5 is a diagrammatic drawing in sectional plan view of a combustion chamber of Figure 3 showing a two-level gas pipe gas burner therein;

Figure 6 is a front view of a vented fireplace comprising the novel ceramic combustion chamber and a fabricated metal base support;

Figure 7 is a diagrammatic drawing in plan view showing the base support of Figure 6;

Figure 8 is a front view of the base support of Figure 6 and 7 with the front trim panel and transfer support bar removed;

Figure 9 is a section in side elevation taken through a modified assembled ceramic combustion chamber completed for installation as a horizontal vented zero clearance fireplace;

Figure 10 is a section in side elevation taken through a modified assemble ceramic combustion chamber completed for installation as a vertical vented zero clearance fireplace;

6

Figure 11 is a diagrammatic isometric view of the novel assembled non-porous cast ceramic combustion chamber before modification for use as an unvented fireplace, a vented fireplace or a direct vented fireplace with or without a heat exchanger modification;

Figure 12 is a plan view of a floor or top panel of a novel ceramic combustion chamber illustrating a second preferred embodiment panel;

Figure 13 is a section taken at lines 13-13 of Figure 12;

Figure 14 is a section as it would appear if taken at lines 13-13 through a top panel when reverse oriented;

Figure 15 is an enlarged section in elevation taken through a floor panel showing a preferred metal flat pan burner;

Figure 16 is an enlarged and section in elevation taken through a floor panel showing a non-porous ceramic flat pan burner;

Figure 17 is an enlarged section in elevation taken through a floor panel showing another non-porous ceramic flat pan burner;

Figure 18 is an enlarged section in elevation taken through a floor panel showing a composite metal/non-porous ceramic flat pan burner;

Figure 19 is an enlarged detail of a vertical joint formed by a side and a rear panel of a ceramic combustion chamber having three vertical panels;

Figure 20 is an enlarged detail of a another vertical joint formed by a separate side and rear panel; and

Figure 21 is a block diagram showing the steps preferably employed to form the panels used in the novel gas combustion chamber described in the Figures hereinbefore.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Refer now to Figure 1 showing a vented gas fireplace unit 10 in side elevation taken through the novel assembled non-porous cast ceramic fiber combustion chamber 11. The combustion chamber 11 comprises a top panel 12, a rear panel 13 and a bottom or floor panel 14. The floor panel 14 is provided with an aperture 20 in which a flat pan gas burner 15 is placed either below or at the surface of the floor panel 14. The flat pan burner 15 is shown connected to a gas valve 16 via a gas connection pipe 17. Air for combustion at the gas burner 15 enters through the louvered cover 19 and passes as burning gas around the logs 18 and is exhausted through the exhaust stack 21. A glass front panel 22 may be provided on the vented gas fireplace unit 10 or may be removed if so desired. A decorative surround panel 23 formed as a simulated brick mantel piece is mounted directly to the studs 24 which are used to form a chase or enclosure around the combustion chamber.

Refer now to an enlarged front view of the vented fireplace 10 shown in Figure 1. The decorative surround panel 23 is provided with an aperture in which the combustion chamber 11 is placed. The combustion chamber 11 is further provided with a decorative brass trim 25 which complements the surround panel 23. The panel 13 in the back and side of the combustion chamber 11 is shown having a simulated brick embossed surface which complements the surround panel 23.

Refer now to Figure 3 showing a side elevation taken through a modified assembled ceramic combustion chamber which has a metal rear panel 29. The metal rear panel and the rear panel 28 of a fireplace enclosure form a heat exchanger rear wall 31. A similar heat exchanger wall 27 is formed between the top panel 12 and the top metal panel of the fireplace enclosure 26. A bottom heat exchanger wall 32 is formed between the bottom or base of the fireplace unit 10 and the bottom or floor panel 14. A blower 33 is installed in the bottom wall 32 of the fireplace unit and moves air from the outside room through walls 32, 31 and 27 to form a heat exchanger for the combustion chamber 11. A baffle 34 is shown in installed in the upper and rear portion of the combustion chamber 11 to increase the exhaust gas flow and efficiency to the heat exchanger.

9

Refer now to Figure 4 showing a diagrammatic drawing in sectional plan view of the combustion chamber 11 of Figure 1. The aforementioned rear panel 13 and the side panels 35 and 36 are preferably made from a non-porous cast fiber reinforced insulating material which will be described in greater detail hereinafter. The combustion chamber 11 is shown assembled from panels 13, 35 and 36 and the floor panel 14 before the top panel 12 is assembled and not shown. Corner brackets 37 and 38 are preferably provided at the sharp edges of the combustion chamber 11 to provide corner reinforcements. The corner brackets 37 and 38 are preferably attached to the combustion chamber 11 with high temperature adhesives. However, it will be understood that ordinary silicon caulking compound which is durable up to 500 degrees Fahrenheit may also be used as an adhesive to attach the corner brackets 37 and 38. The aperture 20 through which the flat pan burner 15 is installed is shown in the rear and center of the combustion chamber 11. It will be understood that other types of apertures and other types of burners may be used within the universal combustion chamber 11 as will be explained hereinafter.

Refer now to Figure 5 showing a diagrammatic drawing in sectional plan view of the combustion chamber of Figure 3. The combustion chamber 11 in this drawing is shown provided with a two-level pipe burner 39 and an appropriate aperture for a combustion gas pipe will be

provided in the floor or bottom panel 14. The side walls 35 and 36 are preferably abutted against the rear panel 29 of the heat exchanger and is overlapped by the back panel 28 or the back wall of the fireplace enclosure 28. These panels may be attached with high mechanical fasteners because the heat which passes through the panel 29 is intended to be hot enough to serve as a heat exchanger for the back wall 31 as explained hereinbefore.

Refer now to Figure 6 showing a front view of a vented fireplace which comprises the aforementioned novel ceramic combustion chamber 11 which comprises two side walls 35 and 36, a top wall 12, a bottom wall 14 and a rear wall 13. The edges of the aforementioned walls 43 are shown exposed but may have attached thereto either decorative trim or surround pieces as described hereinbefore. The combustion chamber 11 is further provided with a fabricated metal base 41 onto which a trim piece or closure piece 42 is attached. A baffle 34 is installed in the combustion chamber 11 and supported therefrom by means not shown. The stack 21 is shown attached to the combustion chamber by means of a collar 44 and screws 45. It will be understood that the fiber reinforced ceramic material is thick enough and dense enough to accept conventional screws for attachment purposes.

Refer now to Figure 7 showing a diagrammatic drawing in plan view of the base support 41. The base

support 41 is preferably formed from a single piece or three pieces of sheet metal to form an enclosure or surround which nests at the outer edges of the floor or bottom panel 14. In the preferred embodiment of the present invention, a transverse support bar 46 is provided between the two side panels of the base support 41 and used to support the aforementioned gas valve 16 and flat pan burner 15.

Refer now to Figure 8 showing a front view of the base support 41 and support tabs 47 which are formed by piercing tabs from the panel metal and diverting it from a vertical axis into a horizontal axis by bending the tab inward. The front of the metal base 41 may be closed by the trim piece 42 or the trim piece 42 may be made in the form of a louver for access air. However, by making the tabs 47 from the parent panel metal, air is capable of passing through the apertures made when the support tabs are formed.

Refer now to Figure 9 showing a section in side elevation through a modified assembled ceramic combustion chamber 11 which is completed for installation as a horizontal direct vented zero clearance fireplace. The numerals used in the previous figures which are substantially the same as those employed in Figure 9 are number the same and do not require additional description. The fireplace 11 is shown provided with a horizontal stack 48 which is adapted to fit onto the rear of the rear panel 13 of the combustion chamber 11 by a collar 49. Surrounding

12

the collar 49 is a combustion air chamber 51 which extends downward along the back of the rear panel 13 and forms a plenum 52 for providing a fresh air passageway into the bottom of the combustion chamber through either into the wall 32 or through an aperture 53 into the combustion chamber 11. It will be understood that the plenum 52 shown along the back of the rear panel 13 may be formed as a duct which enters the bottom or the sides of the combustion chamber 11 but still forms a duct for communicating fresh combustion air into the combustion chamber.

Refer now to Figure 10 showing a side elevation taken through a modified assembled ceramic combustion chamber completed for installation as a vertical zero clearance fireplace. The aforementioned plenum 52 is shown as a plenum 54 which also passes down the rear of the rear panel 13 of the combustion chamber 11 and communicates with the rear or bottom of the combustion chamber 11 at panel 14. In the preferred embodiment of the present invention, it is desired to bring the fresh combustion air down below the floor panel 14 and to permit it to rise along the edges of the flat pan burner 15 so as to effect a more complete combustion and flame color around the decorative logs 18. The vertical stack 21 is adapted to the combustion chamber 11 by a collar 49 and the plenum or passageway 54 is formed from sheet metal and attached to the top and rear of the panels 12 and 13 of the combustion chamber 11. The numerals

13

in the Figure 10 are the same as those employed in Figure 9 and do not require additional explanation.

Refer now to Figure 11 showing an isometric view of a novel assembled non-porous cast ceramic combustion chamber 11 before modification for use as an unvented fireplace or as a vented fireplace or as a direct vented fireplace with or without a heat exchanger modification.

The novel combustion chamber shown in Figure 11 is preferably made from an alumina silicate fiber solution, or an equivalent, with a binder and mixed to agitate the fibers to absorb the solution. Once the mixture of fibers forms a slurry as thick as a paste, it may be molded into any desired shape. The trapezoidal flat panel shape shown in Figure 11 is a preferred embodiment. However, the top and bottom panels may be made as a segment of a circle and the side walls 35, 36 and 13 may be made as a continuous curved panel. In any event, it is desired that the novel combustion chamber 11 be assembled from at least three pieces. The advantage to employing substantially flat panels is to enable one to ship the novel gas combustion chamber in a knock down kit easily packaged package for a minimum of transportation cost.

Insert a. a. Refer now to Figure 12 showing a plan view of a floor or top panel of a novel ceramic combustion chamber illustrating a second preferred embodiment panel. The panel 14 shown in Figure 12 is provided with grooves 55 which will

14

accept and precision locate the aforementioned side panels 35, 36 and the rear panel 13.

Refer now to Figure 13 showing a section taken at lines 13-13 of Figure 12 and showing the aforementioned groove 55 which will accept a side panel 36 and precision locate it therein. Similarly, a groove 56 is shown in Figure 14 which is identical to the groove 55 shown in Figure 13. When the panel 14 is reversed 180 degrees, the groove on the left side of the lower panel becomes the groove on the right side for the upper panel.

Refer now to Figure 15 showing an enlarged section in elevation taken through a floor panel 14 showing a preferred embodiment metal flat pan burner 15 located in an aperture 20 which is preferably formed by cutting dies.

Refer now to Figure 16 showing an enlarge section in elevation taken through a floor panel 14 showing a non-porous ceramic flat pan burner 57 formed by drilling gas port apertures 58 into the floor panel 14 and providing air access slots 59 adjacent thereto. In the preferred embodiment shown in Figures 16, the lower portion of the flat pan burner is formed by non-porous ceramic fiber reinforced material the same as a metal flat pan burner and the bottom portion 61 has the same interior spacing as a flat pan burner 15 so as to provide the same gas distribution within the flat pan burner as before. The lower portion of the flat pan burner 57 is preferably

15

attached to the lower or bottom panel 14 by mechanical attachment means as well as adhesives.

Refer now to Figure 17 showing an enlarged section in elevation taken through a floor panel 14 which has machined therein the interior dimensions of a flat pan burner 15 shown as the area 62. Gas ports 63 are drilled or punched in the panel 14 opposite the lower pan portion 64 which is attached to the bottom panel 14 by mechanical and adhesive means and provided with air slots 65 extending through both parts 64 and 14.

Refer now to Figure 18 showing an enlarged section in elevation taken through a floor panel 14 showing a composite metal and non-porous ceramic flat pan burner. The upper portion of the flat pan burner is similar to that described with reference to Figure 17 and is provided with gas ports 63 which communicate with a lower metal pan portion of a gas pan burner 66. Air slots 65 are provided through the panel 14 to provide combustion air for the burner 66.

Refer now Figure 19 showing an enlarged detail of a vertical joint formed by a side panel 35 and a rear panel 13 held together by a corner support bracket 37 which is preferably attached with a high temperature adhesive or even a silicone caulking compound.

Refer now to Figure 20 showing in enlarged detail of another vertical joint formed by a side panel 35 and a

16

rear panel 13 which are held together by a reinforcing spline 67. Again, it is preferred that the panels be closed with a high temperature cement to assure that they are exhaust gas leak proof.

Refer now to Figure 21 showing a block diagram of the steps employed to make a moldable and castable slurry or paste of reinforced ceramic fibers used to make panels which are used to assemble the novel universal gas combustion chambers. In block 69 fibers of alumina silicate are mixed with a binder solution which is in aqueous form. The preferred aqueous solution is a binder of amorphous silicate which may be purchased from Nalco Chemical Company in Naperville, IL under the designation Nalco 1140. The high temperature reinforced fibers preferably are made from a mixture of silica and alumina ($Si0_2$ and Al_20_3) which are mixed and then melted and formed as fibers by blowing drops or portions of the melted mixture to form fibers that are graded by length and preferably are in a form of 1/2 to 1-1/2 inches in length when mixed with amorphous silica. After the combination of fibers and binder solution are mixed together, they are agitated so that the fibers completely absorb the binder solution as shown in block 70. After the mixing and agitation occurs, a slurry or paste is formed as shown in block 71 which is of a consistency which permits pouring or filling into molds or casting receptacles. The slurry or paste is then molded or cast or

17

formed into this desired shape as shown in block 72. The molding and casting of a desired shape of the paste may be formed on a continuous line in a flat panel form in which case the material is passed into a drying oven and would not require removal from a mold as shown in block 73. The step performed at block 73 could be a progressive stamping mold or a rotary mold. After the material passes from the molding or casting operation at block 73, it is dried as molded panels by firing or by holding in heated molds to dry off the water from the green paste mold. In the preferred embodiment, firing is accomplished at temperatures between 350 degrees Fahrenheit up to 1800 degrees Fahrenheit to drive off the water solution which comprises up to 25% by weight.

After drying or firing the panels at block 74, the panels are trimmed or machined to a preliminary shape or trimmed or machined to a final shape at block 75. Apertures and slots and gas ports and burners are formed therein, depending on the intended use of the panel. It will be appreciated that in some forms of individual molds, the edges of the dried panels are so precise that they do not require machining when being fitted together to form an assembled gas combustion chamber. After forming the desired panels in the desire shapes with the desired slots, holes and burners which may be formed by drilling or punching, the panels may be assembled into a combustion chamber shown in

block 76 if the production operation is a continuous operation. However, if the panels to be assembled into a combustion chamber are for assembly at a production site or installation site, it is preferred that individual kits be manufactured from which assembled combustion chambers may be made on site to assure minimum damage and minimum cost of shipping. Thus, the desired panels for a particular preformed gas combustion chamber are packaged as a set of preformed parts for shipment as shown in block 77.

Having explained a preferred embodiment of the present invention used in several different types of fireplaces, it will be appreciated that use of a universal combustion chamber greatly reduces the factory inventory as well as the field site inventory of combustion chambers. The fired and dried fiber reinforced combustion chamber is slightly hydroscopic but non-porous to exhaust gases and may be sealed without a steel or reinforcing backing layer even when used for burning wood logs. The reinforced panel can be made thicker and stronger for wood logs so as to meet wood stove standards and impact tests performed by underwriters as well as meeting zero clearance outside temperature of 160°F if needed.

Manufacturers of Refractory Ceramic Fibers (RCFs) and aqueous binders publish data sheets on several different RCF. While the exact formulation may differ, the preferred silicate base is vitreous alumina silicate for making high

temperature ceramic fibers. An equivalent silicate fiber would be operable when combined with a compatible RCF binder.

20